"purpose is that of which all determinate sequence is the phenomenal expression." "Naturalism proclaims that I am just a little bit of nature, differentiated from the rest, a minute cluster of phenomena in relation with the total remainder of phenomena, a tiny, if somewhat complex configuration under the influence of the major configuration of the universe." But "I cannot do away with the conviction that there is something within me which unifies and relates and orders the configurations, something which is the source of my conception of causal agency. It is what I understand by *purpose*." . . . "But why should I suppose that the causal agency which, as purpose, underlies my own private and peculiar configuration, is of a different order of being from that of which nature at large is a manifestation. Just in so far as I *am* one with nature, and therefore in physical relationship with other manifestations in terms of matter and energy, is the purpose of my being one with the purpose which underlies the manifestations of nature, and am I in spiritual relationship with a wider and richer purpose which is thus manifested."

We agree so heartily with this higher teleology that we have no criticism to offer. We doubt, however, whether it is necessary to deal so generously with the naturalistic interpretation in its mechanistic expression as the author has seen fit to do. It may be well methodologically to deal with it as an ideal, but we cannot help feeling that its realisation is very far from being within the sphere of practical politics. Our other difficulty is that we cannot think of the concept purpose except as related to personality, except as an attribute or aspect of a larger reality still, which thinkers of all ages have spoken of as "Spirit."

J. A. T.

TWO BOOKS ON THE SOIL.

Bodenkunde. By E. Ramann. Second edition. Pp. xii+431. (Berlin: Springer, 1905.)

Soils and Fertilisers. By Prof. H. Snyder. Second edition. Pp. x+294. (Easton, Pa.: The Chemical Publishing Co., 1905.) Price 1.50 dollars.

DR. RAMANN'S treatise on soils, which has grown out of an earlier book on forest soils published in 1895, is of very different type and design from such books on the same subject as have appeared in English. In the first place, a considerable portion of the book is occupied with a somewhat generalised and academic consideration of the soil, its origin, its relation to climate and vegetation, its types, &c., in all of which the point of view of the geographer, the geologist, or the botanist is more to the fore than that of the farmer. Soils and their constituents and properties are classified and described as though they were a set of museum specimens, with little or no reference to their behaviour in the field. Indeed, the author has rather a passion for classification, and the work contains too many generalisations and definitions of the following kind, which are accorded the dignity of large type.

"*Bodenkraft* is the sum of all the chemical and physical properties of the soil. *Fruchbarkeit* is the relation between *Bodenkraft* and the development of plants. *Ertragsvermögen* is the relation between *Fruchbarkeit* and climatic factors in their action upon plant colonies or single kinds of plants."

Such definitions sound well in lecture, and serve to fill the industrious listener's notebook, but they do not help him much in the study of the real thing.

Similarly, in those sections of the book dealing with the examination of soils, we get directions for the carrying out of this or that determination—chemical analysis, water capacity, specific heat, &c.—but of the interpretation of the results we hear nothing at all. We are not, in fact, instructed how to add up that sum which is to indicate the fertility of the soil. But in its own special line Dr. Ramann's book cannot fail to be useful to our workers at the scientific study of soils. It is particularly good in dealing with the part of the subject most neglected in Britain, the physical properties of soils, and the portion in which Dr. Ramann is perhaps specially interested—the study of forest soils—contains an excellent summary of work that is almost unknown here. Such matters as the growth of forest soils, the effect of the leafy covering on the chemical composition, the temperature and the water content of soils, are dealt with at length; as again in later chapters are the questions of zones and types of soil and their delimitation upon soil maps. As a book of reference to modern German research on the soil (French and English investigations are practically ignored) Dr. Ramann's treatise will be of considerable service to the specialist; for the agricultural student or the farmer it will not serve.

Prof. Snyder's little book has been constructed out of a series of notes supplied to the students of his classes at the University of Minnesota, expanded somewhat and made more complete by the addition of descriptions of laboratory experiments upon soils and fertilisers. Essentially, however, the book still consists of notes which will serve to remind the student of the matter dealt with in the lectures; they lack both the filling in and the elucidation that comes from the lecturer himself. Too many things are mentioned and left without any adequate explanation, as though the author were afraid to pass them by wholly without notice, yet knew at once that he could not afford the time or space necessary to develop them properly. The result is a book which fulfils its original purpose of lecture notes, but when taken by itself is dull and difficult to read, and, as we would contend, a mistake educationally. A text-book should not be a miniature encyclopædia, and though the teacher is well advised in making occasional excursions into higher work beyond the average reach of his students, it should be done by working out principles, and not by scrappy enumerations of more advanced investigations.

But instead of criticising a book for what it is not, it is fairer to try and appreciate what it does accomplish. Prof. Snyder is a well known member of the band of American experiment station workers who have done so much to advance the application of science to the everyday practical side of farming, and have succeeded in making the United States

farmer regard the investigator as his necessary helper in the conduct of his business.

In matters connected with the physics of the soil and its bearing upon the operations of cultivation the American workers have accumulated much novel information, and to this some of the chapters of Prof. Snyder's book form a good introduction. The requirements of the crop are treated from a sound general standpoint which never forgets that water and air, soil texture, and cultivation are perhaps the prime factors in plant production. In this country students are a little too apt to fancy that farming begins and ends with the application of artificial manures; we can recommend this book to them for the truer point of view, even though the conditions which regulate our use of manures are not quite the same as in America.

RECENT ASPECTS OF ELEMENTARY GEOMETRY.

The First Book of Geometry. By Grace Chisholm Young, Ph.D., and W. H. Young, M.A., Sc.D. Pp. xvi+222. (London: J. M. Dent and Co., 1905.) Price 1*s.* 6*d.* net.

OF late years a very remarkable change has been made in the theory of elementary geometry, the general effect of which has been to make it more abstract, and to reduce a great deal of it to the application of logic without any appeal to intuition. It has been realised that geometry must be based on the assumption of certain undefinable entities, of elementary relations between them, and a complete system of independent axioms. For the purposes of ordinary Euclidean geometry, it is probably the simplest way to assume the straight line as the one undefinable entity, and intersection as the elementary relation from which the notions of point and plane may be derived. What system of axioms we adopt will partly depend upon the nature of the geometry we study; for instance, the axioms which are necessary and sufficient for the purposes of projective geometry require supplementing when we discuss the theory of measurement.

It is the theory of measurement which presents the greatest difficulty at the present time. If we assume all the results of projective geometry, we may proceed as follows:—Taking any three points O, I, X on a line, we may associate them with the numbers (or indices) 0, 1, ∞ (where ∞ is the vague infinity of ordinary arithmetical algebra). We can then give a purely projective rule for finding a point on the line to be associated with any given rational number p/q; we thus get on the line a set of points corresponding to the whole field of rational numbers, and, moreover, the arrangement of the points corresponds to the arrangement of the numbers according to their magnitude; that is, if $m>n>p$, the point N lies on that segment MP which does not contain X. If we like, we can define the distance AB as being measured by $b-a$, where a, b are the indices of A, B. This satisfies the relation AB+BC=AC, but equal segments as thus defined are not intuitionally equal, except when X is "the" point at infinity on the line; and even then we cannot prove, but must assume the intuitional equality. Moreover, there are points on the line which do not have rational indices, unless, in spite of common sense, we assume that the points on the line form a discrete aggregate. Now in arithmetic we have a perfect continuous aggregate, where each irrational element separates all the rational ones into two complementary parts, respectively greater or less than itself. If we *assume* that all the points in the line which have not rational indices behave in a similar way, we have a complete correspondence between the succession of points on a line and the elements of the arithmetical continuum. So far as appears at present, this is a pure assumption; but if it is not made, anything like the ordinary theory of measurement seems to be impossible, for two distinct points ought to have a measurable distance, and the measure must be a number; if the two distinct points cannot be associated with two distinct numbers, how is their distance to be defined as a measurable quantity? Other difficulties arise in connection with transfinite numbers and their representation by point aggregates; but these are comparatively unimportant, if it is remembered that the assumption of the correspondence of points on a line with the arithmetical continuum involves a similar correspondence between the arithmetical continuum and the points on any finite segment.

It is very interesting to see how this recent theory has reacted on the question of teaching elementary geometry. Instead of tending to make it more abstract and more logical, it has done exactly the reverse; and the reason for this is not difficult to find. The notions of geometry, so far as it is distinct from logic, are derived from concepts, and these, again, from experience. There must be an intuitional basis for geometry; and although, from a logical point of view, it is desirable, *for any given species of geometry*, to reduce its necessary assumptions to a minimum, progress in geometrical invention is to be expected from those who cultivate their powers of observation as well as their logical faculties. One result of recent research has been to explode, once for all, the pretence that the "Elements" of Euclid present geometry in its most logical form; on the other hand, to try to teach beginners the subject in what would now be considered the most rigorous way would be certain to end in failure.

The book which has been written by Dr. and Mrs. Young illustrates very well what has just been said. Its main object is to awaken the pupil's mind to the ideas by which we classify the properties of space; this is done by directions in paper-folding, in dissection of areas, in the construction of solid models, and the like. At the same time, various theorems are stated and proved, so that the beginner may learn the difference between experimental and deductive geometry. As in the case of other text-books with a similar aim, the teacher will have to be careful to see that his pupil distinguishes proofs from verifications; *e.g.*, on p. 173 we have a proof that the angles of a triangle make up two right angles, while on p. 121 we have a verification in a special case.